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(54) GAS TURBINE ENGINE IGNITER ASSEMBLY

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the laws of the State of New York, United States of America, residing at 1 River Road, Schenectady 12305, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to gas turbine engine igniter assemblies.

According to the present invention there is provided an igniter assembly for a gas turbine engine combustion system which includes an outer duct wall bounding a first gas flow path and an inner duct wall bounding a second gas flow path, said igniter assembly comprising a hollow housing for extending through the outer duct wall, said housing having a threaded portion associated therewith, sealing means for reducing fluid flow between the exterior of said hollow housing and the inner duct wall, said sealing means including a threaded opening for receiving said threaded portion of said housing and said housing including a wrenching surface whereby said threaded portion may be threadedly connected in said threaded opening.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 illustrates a turbofan engine in which the present invention is embodied;

Figure 2 is an enlarged portion, in section, of Figure 1 showing one embodiment of the present invention;

Figure 3 is an enlarged view, with portions deleted, of a portion of Figure 2;

Figure 4 is a sectional view taken along line 4—4 of Figure 3;

Figure 5 is a top plan view taken in the direction of line 5—5 of Figure 4; and

Figure 6 is a sectional view, similar to Figure 2, illustrating an alternative embodiment of the invention.

Referring now to the drawings wherein like numerals correspond to like elements throughout, Figure 1 illustrates, in simplified form, a turbofan engine which is capable of use in the propulsion of aircraft. This engine comprises an outer duct wall 10 and an inner duct wall 12. A gas generator 14 is disposed within the duct wall 12 to generate a hot gas stream for driving a fan turbine 16. This turbine is connected by a shaft 18 to a bladed rotor or fan 20 which pressurizes an airstream. The outer annular portion of this airstream passes between the duct walls 10 and 12 and is discharged from a propulsive nozzle 22 to provide a propulsive force. The inner portion of the airstream, pressurized by the fan 20, is further pressurized by a compressor 24 of the gas generator 14 to support combustion of fuel in a combustor 26. The hot gas stream then drives a turbine 28 connected through a shaft 30 to the compressor 24. After driving the turbine 28, the hot gas stream then drives the fan turbine 16 as previously described, and is discharged through a propulsive nozzle 32.

Various structural support means can and have been devised to mount the above-described, basic turbofan components relative to one another and the engine as a whole to an aircraft frame. However, it will be apparent that due to the temperature differentials between the airstream passing between the duct walls 10 and 12 and the temperature of the airflow within the duct wall 12 that differential thermal expansion between the duct walls in both the radial and axial directions will occur. In the normal situation, the differential radial expansion will be a dominant factor in designing any fitting for any structural member which must traverse the duct walls 10 and 12.

Thus, an igniter assembly 34 is provided which traverses the duct walls 10 and 12. The igniter assembly 34 houses electrical leads to an electrical spark-type igniter 36

which initiates combustion of fuel being burned within the combustor 26. Figures 2—5 illustrate the igniter assembly 34.

As shown in these Figures, the igniter assembly 34 includes the igniter 36, which is provided with some suitable means for generating an ignition spark, such as an igniter tip 38, and a pair of electrical conductors 42 and 44 which are separated by a length of electrical insulating material, such as ceramic material 45. The length of material 45 is received in a casing 40 which is joined to the igniter 36 at an enlarged flange 46, the purpose of which will become apparent. From the end of the casing 40 opposite that of the enlarged flange 46 extends a flexible lead 48, which includes a pair of conductors 50 and 52 which connect to a suitable source of power (not shown) associated with the gas turbine engine. While the electrical connecting means may take many forms, as shown in Figure 2 the connection means may comprise a simple threaded connection including an internally threaded nut 54 which forms a portion of a male connector. As further shown in Figure 2, a rigid elbow section 55 may be used to surround the flexible lead 48 at a position where the lead 48 extends through the outer duct wall 10 of the engine. As seen in Figure 2, the duct wall 12 comprises first and second wall members 12a and 12b bounding an annular space 80.

The igniter assembly further includes a generally cylindrical-shaped housing 56 which surrounds the length of insulating material 45 and its casing 40 and a portion of the lead 48 as shown in Figure 2. The housing 56 includes an enlarged inner end 58 having associated therewith a threaded portion 60, which is adapted to be threadably received in a seal ring 62 associated with the first wall member 12a of the inner duct wall 12. The seal ring 62 is connected to the wall member 12a in any suitable manner, such as by means of a threaded connection 64. For this reason, the wall member 12a is provided with an enlarged boss section 66 which includes a central threaded opening 68 for receiving the seal ring 62. The seal ring 62 includes an enlarged flange 70 which abuts an outer face 72 of the boss portion 66.

As further shown in Figure 2, the sealing ring 62 is sized so that when the flange 70 engages the outer face 72 of the boss 66, a bottom wall 74 of the ring 62 cooperates with the surface of the inner duct wall 12 to define a smooth flow surface 76. Furthermore, when thus assembled the flange 70 and the outer face 72 cooperate to form a gas seal which precludes the flow of air between a chamber 78 on the inner side of the duct wall 12 and the space 80 within the duct wall 12.

Similarly, the sealing ring 62 includes a central opening 82 which receives the igniter 36 so that the flange 46 of the casing 40 of the insulating material 45 may engage a flat portion 84 of the seal ring 62. While the abutting relationship of the flange 70 and outer face 72 precludes the flow of air between the seal ring 62 and the duct wall 12, the abutting relationship of the flange 46 and the flat portion 84 precludes the flow of air between the igniter 36 and the seal ring 62. Thus, the flow of hot air from the chamber 78 to the space 80 is substantially precluded when the igniter 36 is positioned within the seal ring 62 as shown in Figure 2.

In order to provide for the installation of the igniter assembly 34, the outer end of the housing 56 includes an integrally formed wrenching surface 86 which, in the present instance, lies outside the engine outer duct wall 10, but may be located at any position along the length of the housing 56. A wear collar 87 may be provided around the flexible cable 48 where the wrenching surface 86 surrounds the cable 48. Installation is accomplished simply by placing the igniter 36 within the opening 82 and thereafter rotating the housing 56 by means of the wrenching surface 86 until the bottom end of the housing 56 comes into contact with the enlarged flange 46 of the casing 40 and applies a sufficient load to the flange 46 to maintain a tight seal between the flange 46 and the flat portion 84 of the seal ring 62. In most applications, the threaded opening in the seal ring 62 and the threaded portion of the housing 56 would be provided with self-locking threads to eliminate the need for safety wiring or some other positive means of assuring continued engagement.

Installation of the igniter assembly 34 is accomplished as described above without the necessity of imposing a torque load on any portion of the igniter itself. That is, installation is accomplished by rotating the housing 56, which surrounds the igniter 36, the material 45 and its casing 40, and a portion of the cable 48, but is free to rotate with respect to each of these members. In this manner, a compressive force is imposed on the flange 46 to provide the necessary sealing, but no torque load is applied to the igniter 36 and the relatively fragile ceramic insulation 45 and the cable 48. Problems associated with prior art installation techniques which did impart torque to the igniter are thus alleviated.

As described above, the inner end of the igniter assembly 34 is constrained to move both radially and axially with the inner duct first wall member 12a as the duct wall 12 is subjected to varying temperatures during operation of the gas turbine engine. All other intersections of the igniter assembly

34 and other structural components of the gas turbine engine are provided with floating seals to accommodate the relative thermal expansion between the igniter assembly 34 and the various structural members.

In order to accomplish the desired sealing at the combustion zone itself, a combustion liner 88 which defines the combustion chamber portion of the combustor 26 is provided with a floating seal cup 90, which is connected to the combustion liner 88 in any suitable manner. For example, as shown in Figures 3—5, the seal cup 90 may be connected to the liner 88 by means of a collar 92 which surrounds a lip portion 94 of the cup 90. The collar 92 is connected to the liner 88 by welding or brazing a pair of leg members 93 which extend from two sides of the collar 92 directly to the liner 88. The floating seal cup 90 includes a tapered inlet 95 which alleviates assembly mismatch problems during insertion of the igniter assembly 34 through the various structural members of the engine. As clearly shown in Figures 3—5, the collar 92 provides an opening 97 which is sufficiently large to permit movement of the seal cup 90 in response to thermal movement of the liner 88 and the igniter 36.

Similarly, the inner duct second wall member 12b includes a floating seal cup 98 having a tapered inlet 100 which receives the enlarged end portion 58 of the housing 56. The seal ring 98 is captured by a collar 102 which is connected to the second wall member 12b by means of a plurality of bolts 104. As shown in Figure 2, the collar 102 provides an opening 106 which receives a leg portion 108 of the seal ring 98. The leg portion 108 is thus captured between the second wall member 12b and the collar 102, but the opening 106 is sufficiently large so as to permit slight axial movement of the seal ring 98 in all directions.

As is true with the seal ring 90 and the igniter 36, the seal ring 98 provides a central opening which receives the enlarged end section 58 of the housing 56, and this opening is sized so as to minimize the amount of air flow between the seal ring 98 and the housing 56. As with the seal ring 90, the tapered inlet alleviates mismatch problems during insertion of the igniter assembly 34 into its proper position within the engine.

Finally, the intersection between the outer end of the housing 56 and the outer engine duct 10 may also be provided with a floating seal 110. The seal 110 may be similar to the seal rings 90 and 98 or, in order to minimize the envelope of the engine and provide a substantially flat outer duct wall 10, the seal 110 may take the form of one of those shown in our U.S. Patent No. 3,572,733. In any case, the seal 110 minimizes the flow of gas between the outer duct wall 10 and the housing 56.

In many applications, it may be necessary to cool the igniter assembly 34, especially in the region of the igniter 36. Cooling of the illustrated embodiment is accomplished by providing one or more cooling holes 112 in that portion of the housing 56 which is positioned within the fan flow path. In such a case, relatively cool fan air would enter the housing 56 and would flow around the casing 40 and a portion of the flexible cable 48, cooling the same. This cooling air could then be dumped by sizing the wear collar 87 and the top of the housing 56 such that cooling air could flow out of the housing 56 around the wear collar 87.

As shown in Figure 6, an alternative apparatus may be constructed wherein a second electrical connection is made near the top of the housing 56. The electrical connection may take any form and as shown in Figure 6 may consist of a simple threaded connection including a male connector 114 and a female receptacle 116. The female receptacle 116 includes a wrenching surface formed integrally with the casing 40 which now extends throughout the entire length of the housing 56.

The alternative embodiment shown in Figure 6 may find use in certain applications but certain advantages inherent in the embodiment of Figures 2 to 5 are not present in the embodiment of Figure 6. For example, a single electrical connection is all that must be broken in order to remove the igniter assembly 34 shown in Figure 2. However, the advantage of simple replacement of the igniter 36 is inherent in both the embodiments because the threaded, internal connection at the duct wall member 12a would be provided in both cases.

WHAT WE CLAIM IS:—

1. An igniter assembly for a gas turbine engine combustion system which includes an outer duct wall bounding a first gas flow path and an inner duct wall bounding a second gas flow path, said igniter assembly comprising a hollow housing for extending through the outer duct wall, said housing having a threaded portion associated therewith, sealing means for reducing fluid flow between the exterior of said hollow housing and the inner duct wall, said sealing means including a threaded opening for receiving said threaded portion of said housing and said housing including a wrenching surface whereby said threaded portion may be threadedly connected in said threaded opening.

2. An igniter assembly as claimed in claim 1 wherein said housing houses at least a pair of electrical leads separated by a length of relatively rigid electrical insulating material received in a casing, and means for generating an ignition spark, said housing being freely rotatable with respect to said casing and said electrical insulating material.

3. An igniter assembly as claimed in claim 2 wherein said casing includes a flange portion, and said sealing means includes a seal ring having said threaded opening therein, said seal ring including a flat portion adapted to come into contact with said flange portion when said housing is threaded into said opening, the mutual contact of said flange portion and said flat portion forming a fluid seal substantially precluding fluid flow between the exterior of said housing and said inner duct wall.

4. An igniter assembly as claimed in claim 2 or claim 3 including a relatively flexible electrical conductor for connection to a power source, wherein said conductor extends from a said lead to the power source, and at least a portion of said conductor lies within said housing, and said housing is freely rotatable with respect to said conductor.

5. An igniter assembly as claimed in any one of claims 2 to 4 including means for directing a flow of coolant between said housing and said casing.

6. An igniter assembly as claimed in any one of the preceding claims wherein said housing in use intersects at least one other structural member of said engine, and sealing means is provided at such intersection to reduce fluid flow between the exterior of said housing and said structural member, said sealing means permitting relative axial and radial movement between said housing and said structural member.

7. An igniter assembly as claimed in claim 6 wherein said last-mentioned sealing means comprises a floating seal cup adapted to engage the exterior surface of said housing.

8. A gas turbine engine including an outer duct wall defining the outer bounds of a fan flow path, an inner duct wall comprising a first wall member defining the outer bounds of a gas generator flow path and a second wall member positioned between said first wall member and said outer duct wall, a combustion chamber liner partially defining a combustion zone, and an igniter assembly comprising a housing extending through said outer duct wall and including a threaded portion near a first end thereof, said housing including a wrenching surface near the opposite end thereof, sealing means for reducing fluid flow between the outer surface of said housing and said inner duct wall, said sealing means including a seal ring having a threaded opening therein, said threaded opening being adapted to receive said threaded portion of said housing, and said wrenching surface being located so as to be accessible from the exterior of said outer duct wall.

9. A gas turbine engine as claimed in claim 8 wherein said housing houses a casing having associated therewith at least a pair of electrical leads, an igniter located at one end of said casing, and a flange portion associated with said casing, said flange portion extending from said casing a relatively short distance from the igniter end thereof.

10. A gas turbine engine as claimed in claim 9 wherein said sealing ring includes a flat portion adapted to contact said flange portion when said housing is threaded into said opening of said seal ring whereby said flange portion and said flat portion form a fluid seal, said housing being freely rotatable with respect to said casing.

11. An igniter assembly for a gas turbine engine substantially as described herein with reference to Figures 2 to 5, or Figures 2 to 5 as modified by Figure 6, of the accompanying drawings.

12. A gas turbine engine substantially as described herein with reference to the accompanying drawings.

BROOKES & MARTIN,
High Holborn House,
52/54 High Holborn,
London, WC1V 6SE,
Agents for the Applicants.

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1 SHEET

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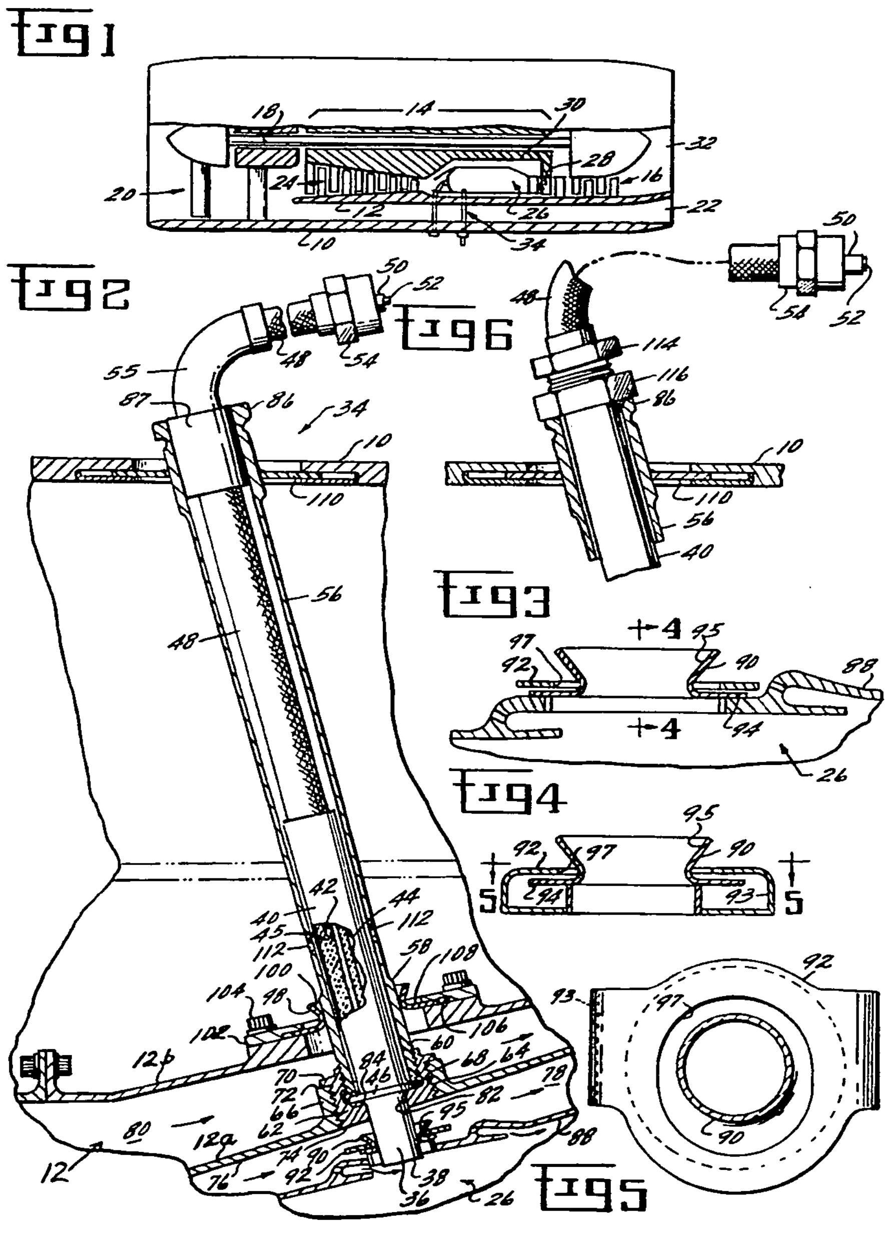

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